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# PATENT SPECIFICATION

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(72) Inventor BRIAN SNOWDON



## (54) IMPROVEMENTS IN OR RELATING TO THE CONVEYING OF BULK MATERIALS

(71) We, MACAWBER ENGINEERING LIMITED, of Ogden Road, Doncaster DN2 4SQ, in the County of South Yorkshire, a British Company, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to apparatus for conveying bulk materials from one point to another and in particular apparatus for moving bulk material from one level to another higher level.

15 The bulk material may be for instance dry particulate material or a slurry. It may contain particles having a maximum dimension of up to 3". The particles may be rather abrasive in nature. A typical material which might be handled by apparatus of the present invention is foundry sand which may be required to be raised to a higher level immediately after being separated from the castings on a "knock out" grid.

25 At present materials such as foundry sand are normally raised by means of an enclosed chain type bucket elevator but such equipment suffers from the disadvantage that temperature changes and the very abrasive nature of the material being conveyed cause high wear rates on the bucket supporting chain and make adjustments of the chain tension necessary every few days.

35 According to the present invention there is provided apparatus for elevating bulk material, comprising a conduit extending between a first level and a second relatively higher level and having a material inlet at said first level and a material outlet at said 40 second level, the material inlet being connected to the closable material outlet of a vessel, the vessel also being provided with a material inlet and the vessel having a further inlet for the introduction of pressurised gas to the vessel, the further inlet 45

being positioned so that material in the vessel may be discharged under pressure into the conduit when the material inlet is closed and the material outlet is open, the conduit being provided with a pressurised gas inlet at said first level whereby a continuous supply of pressurised gas may be supplied to said conduit to maintain material flow therein.

The vessel may form part of the conduit 55 or may, for instance, be in the form of a separate vessel merely being connected directly or indirectly to said conduit via said outlet.

With the vessel at least partly full of the bulk material the inlet may be closed, compressed gas applied to the inside of the vessel and the outlet opened. The position of the compressed gas inlet is such that the bulk material is driven out of the vessel 65 through the outlet and into the conduit. Since the conduit at least in part passes from a first position to a second higher position, the bulk material will eventually be caused to be elevated from said first to said second 70 position, although this may only be achieved after several operations of the apparatus.

Preferably the material inlet and outlet are closable by means of a valve assembly as described and claimed in the Complete Specification of our Patent No. 1,539,079. Such a valve assembly includes a valve member formed from part of a spherical shell of which it forms a part between a position closing the inlet or outlet and a 80 position clear of said inlet or outlet. Such valves are particularly suitable for the present invention in view of the ability of the valve member to slice through a head of bulk material whether abrasive or not and 85 also to form a good seal with the valve housing.

The present invention also provides a method of elevating bulk material from a first level to a second relatively higher level, 90

the method comprising feeding the material to a vessel having a closable material inlet and a closable material outlet when said material inlet is open and said material outlet is closed, said outlet being connected to the inlet of a conduit which extends from said first level to said second level, closing said material inlet, supplying pressurised gas to the vessel and opening said material outlet so that the material is discharged into the conduit, and continuously supplying pressurised gas to the conduit at said first level so as to maintain material flow therein.

An embodiment of the present invention will now be described, by way of example only, and with reference to the accompanying drawing which is a diagrammatic representation of material handling apparatus incorporating apparatus in accordance with the present invention.

Referring to the drawing, apparatus for handling pneumatic material includes a small feed chute 1 which is applied with bulk material from a conveyor 1a. The bulk material may include particles having a maximum dimension of up to 3", the particles being of an abrasive nature. Chute 1 is connected at its bottom narrower end to a valve assembly 2 which is closely similar to that described in accordance with the drawings in the Complete Specification of our Patent No. 1,539,079. In particular the type of sealing arrangement for the valve member used in the valve assembly 2 is similar to that described in accordance with Figure 3 of said drawing, that is to say, a so-called "loose seal" arrangement which may be made of materials which will withstand temperatures up to 300° Centigrade which may be the temperature of the bulk material being conveyed.

Valve assembly 2 is attached to the top of a low pressure transfer vessel 3. Vessel 3 is substantially frusto-conical in shape having a maximum diameter immediately below valve assembly 2. The latter is mounted on top plate 3a of vessel 3, in which plate there is a central circular hole which lies vertical below the narrow end of chute 1.

Attached to and depending downwardly from top plate 3a of vessel 3 is a circular cylindrical skirt 3b which extends to a position close to the sloping wall of vessel 3 so that only a small gap is provided therebetween. The sloping wall of vessel 3 is provided with an inlet 8 at a position between the bottom of skirt 3b and top plate 3a.

Attached to the flanged bottom of vessel 3 is a second valve assembly 4. This valve assembly 4 is substantially identical to valve assembly 2.

Valve assembly 4 is in turn connected to a 180° pipe bend 5. The latter is connected

to a vertical lift pipe 6 which in turn leads onto a horizontal transfer pipe 7. The latter is connected to a storage bunker 11 by means of short vertical pipe 12.

Pipe bend 5 and pipe 6, 7 and 12 have a relatively large diameter compared with those normally used on conventional pneumatic conveying systems.

Provided at the bottom of this pipe 6 is a small diameter air inlet 10 which leads horizontally through the pipe wall to the centre of the pipe where it turns upwardly.

In use valve 2 is opened so that material in chute 1 may enter pressure vessel 3. At this stage valve 4 is closed. When vessel 3 is sufficiently full valve 2 is closed. Compressed air is introduced through inlet 8 and this passes into the vessel and through the narrow gap 9 between skirt 3b and the sloping wall of the vessel. The valve 4 is opened and the compressed air pushes the material through valve assembly 4, along pipe bend 5 to the bottom of lift pipe 6. At this point the air supply is stopped and valve 4 closed. Valve 2 is then opened to allow more material to enter vessel 3. The sequence is repeated until the lift pipe 6 becomes full of material and then material is pushed along pipe 7 and into storage bunker 11.

A small amount of air is continuously introduced through inlet 10 to produce a semi-fluid condition in the material in the lift pipe 6 to prevent blocking of the latter.

#### WHAT WE CLAIM IS:—

1. Apparatus for elevating bulk material, comprising a conduit extending between a first level and a second relatively higher level and having a material inlet at said first level and a material outlet at said second level, the material inlet being connected to the closable material outlet of a vessel, the vessel also being provided with a material inlet and the vessel having a further inlet for the introduction of pressurised gas to the vessel, the further inlet being positioned so that material in the vessel may be discharged under pressure into the conduit when the material inlet is closed and the material outlet is open, the conduit being provided with a pressurised gas inlet at said first level whereby a continuous supply of pressurised gas may be supplied to said conduit to maintain material flow therein.

2. Apparatus according to claim 1 wherein the material inlet and material outlet are each closable by means of a valve assembly which includes a valve member formed from part of a spherical shell which member rotates about the axis of the spherical shell of which it forms a part between a position closing the inlet or outlet and a position clear of said inlet or outlet.

3. Apparatus according to claim 1 or claim 2 wherein the pressurised gas inlet

- of the conduit is connected to means for supplying a stream of air thereto to produce a semi-fluid condition in material located in the conduit.
- 5 4. Apparatus according to claim 1 and substantially as herein described.
5. Apparatus for elevating bulk material substantially as described herein with reference to the accompanying drawing.
- 10 6. A method of elevating bulk material from a first level to a second relatively higher level, the method comprising feeding the material to a vessel having a closable material inlet and a closable material outlet
- 15 when said material inlet is open and said material outlet is closed, said outlet being connected to the inlet of a conduit which extends from said first level to said second level, closing said material inlet, supplying
- 20 pressurised gas to the vessel and opening said material outlet so that the material is discharged into the conduit, and continuously supplying pressurised gas to the conduit at said first level so as to maintain material flow therein. 25
7. A method according to claim 6 and substantially as herein described.
8. A method of elevating bulk material, substantially as described herein with reference to the accompanying drawing. 30

UROUHART-DYKES & LORD,  
Chartered Patent Agents,  
Agents for the Applicants,  
11th Floor, Tower House,  
Merrion Way, Leeds, LS2 8PB  
— and —  
11th Floor, St. Martin's House,  
140, Tottenham Court Road,  
London, W1P 0JN.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
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